SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, JULY 24, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE TWENTY-EIGHTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY.

THE twenty-eighth general meeting of the American Chemical Society was held in Cleveland on June 29 and 30. At the opening session, held in the rooms of the Associated Technical Clubs, Professor Edward W. Morley gave a brief address of welcome in behalf of the Cleveland Chemical Society.

In his reply the president, Professor John H. Long, paid a well-merited tribute to the work of two Cleveland men, Professors Morley and Mabery.

In the afternoon following the first session the members of the society were taken on a most entertaining drive through one of Cleveland's chief industrial centers, where the iron furnaces, the works of the Grasselli Chemical Company and the Standard Oil Company, the ship yards and many minor concerns could be seen to good advantage.

In the evening, the visitors were again the guests of the local society at an informal smoker at the rooms of the University Club. By invitation of the officers of the society, Dr. Gomberg presented a discussion of the subject of trivalent carbon. In a very lucid and interesting talk, he outlined the way in which he was led to the discovery of triphenylmethyl, and the series of proofs by which its structure

may be considered established. He also announced that analogous substances (as, for example, the tritolyl compound) have recently been prepared, showing that triphenylmethyl is only one example of a class. The only hypothesis so far that explains the facts is that carbon is trivalent in these compounds. Specimens and some simple experiments added to the interest of the talk. The speaker was warmly applauded.

After the Tuesday morning session, held in the chemical laboratory of Case School, the Grasselli Chemical Company generously treated the members of the society to a drive through some of Cleveland's beautiful parks, followed by a luncheon at the Hollenden Hotel.

A subscription dinner in the evening was attended by forty-five. The toastmaster, President Long, to use his own phrase, 'swung round the circle,' and called on representatives from the various sections.

There were several excursions to manufacturing establishments of interest to chemists. All in all, the meeting was one of the most enjoyable the society has held, and the vote of thanks to Professor Hippolyte Gruener, to the Cleveland Chemical Society and to other local men who contributed to the enjoyment of the visiting members was hearty and unanimous.

The total attendance was 107, 70 of whom were from places outside of Cleveland.

The next meeting will be held in St. Louis during the first week of January, 1904, in affiliation with the American Association for the Advancement of Science.

Following is a list of the papers presented:

Contributions to the Chemistry of Hydronitric Acid: L. M. Dennis and A. W. Browne.

The acid is best prepared by causing ammonia gas to bubble through molten sodium kept at 350°, and treating the resulting sodium amide with nitrous oxide at a temperature of about 90°. In the second reaction a 90 per cent. yield of the sodium salt, NaN_3, is obtained. Ferric chloride is a good reagent for qualitative tests.

The Transport Number of Sulphuric Acid: O. F. Tower.

An apparatus was described having a platinum cathode and a cadmium anode. At a dilution of one fifth normal the transport number changes only very slightly with increasing dilution, indicating that at the point named practically all the HSO_4 ions have been broken up into $\dot{H}$ and $\overline{\overline{SO}}_4$.

Electrolytic Conduction with Reference to the Ion Theory: Nevil Monroe Hopkins. (By title.)

The Rôle of Water in the Electro-deposition of Lithium from Pyridine and from Acetone: H. E. Patten and W. R. Mott.

Lithium may be deposited, from pyridine and acetone solutions of its chloride, on platinum, iron, aluminum and copper. The deposition is interfered with by the presence of water; in the case of pyridine very seriously so, owing to the formation of a high-resistance film.

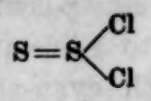
The Viscosity of Solutions of Metallic Salts: Its Bearing upon the Nature of the Compound between Solvent and Solute: Arthur A. Blanchard and Morris A. Stewart.

Change of viscosity with change of concentration is believed to follow a linear formula in cases where no definite hydrates are formed. The formation of a compound with ammonia decreases the viscosity of a metallic salt solution, while pyridine has the opposite effect.

The Vapor Tension of Ammoniacal Copper Sulphate Solutions: JAMES LOCKE. (By title.)

The Constitution of Sulphur Chloride: W. R. SMITH and I. F. B. WADE.

Two facts which speak for the asymmetrical formula



are the synthesis from thionyl chloride and the formation, when sulphur chloride reacts with such substances as zinc ethyl, of compounds containing only one atom of sulphur.

Mercurous Sulphide: CHARLES BASKERVILLE. (By title.)

Attempts to prepare Certain Rare Earth Alums, and on Some New Double Sulphates: CHARLES BASKERVILLE and HAZEL HOLLAND. (By title.)

On the Purification of Neodidymium: CHARLES BASKERVILLE and RESTON STEVENSON. (By title.)

Præseodidymium Tetroxide: CHARLES BASKERVILLE and J. B. THORPE. (By title.)

New Peroxides of Certain Rare Earths: CHARLES BASKERVILLE and T. B. FAUST. (By title.)

Mordanting with the Rare Earths: CHARLES BASKERVILLE and T. B. FAUST. (By title.)

Some New Organic Salts of Zirconium: CHARLES BASKERVILLE and H. H. BENNETT. (By title.)

The Proportions of Silver Nitrate and of Silver Sulphate Formed by the Action of Nitric Acid on Silver Sulphide: HIPPOLYTE GRUENER.

When a large amount of strong acid is used, the product is almost entirely sulphate; the maximum amount of nitrate was obtained by long boiling with 4 per cent. acid; even here 10 per cent. of the product is sulphate.

The Action of Dissolved Oxygen on Cuprous Chloride: W. M. BLANCHARD and BERT D. INGLES.

As previously shown by Vogel, water containing air acts on cuprous chloride according to the equation

$$2Cu_2Cl_2 + O = Cu_2O + 2CuCl_2,$$

but not more than 97 per cent. of the amount present can be so converted. If, however, gaseous oxygen is passed into water containing cuprous chloride in suspension, a bluish basic chloride results.

The Action of Hydrogen Peroxide on Cuprous Chloride: W. M. BLANCHARD.

A chocolate-colored basic chloride is first formed which soon changes to a greenish blue basic chloride supposed to be

$$CuO.CuCl_2.4H_2O.$$

Oxygen is simultaneously evolved.

On the Changeable Hydrolytic Equilibrium of Dissolved Chromic Sulphate: T. W. RICHARD and F. BONNET, JR.

The authors confirm the conclusion of Whitney and Recoura that a green basic substance exists in the green solution, but they show further that the substance is much more basic than was previously supposed. The investigation will be continued.

On the Deposition of Sodium from a Solution of Sodium Iodide in Acetone: H. E. PATTEN and W. R. MOTT. (By title.)

On the Deposition of Zinc Chloride Dissolved in Acetone: H. E. PATTEN. (By title.)

Derivations of Trichlorethylidene-dinitrophenamine: ALVIN S. WHEELER and M. R. GLENN. (By title.)

Some Salts of Triphenylmethyl: M. GOMBERG and L. H. CONE. (By title.)

Triphenylmethylacetate: M. GOMBERG and J. T. DAVIS. (By title.)

2-Amino-3,5-bibrombenzoic Acid, its Nitrile, and Synthesis of Quinazolines from the Latter: Marston T. Bogert and William F. Hand.

Both anthranilic acid and its nitrile can be brominated directly by the nascent bromine obtained by the interaction of potassium bromide, potassium bromate and hydrochloric acid. Anthranilic acid gives, in this way, 2-amino-3,5-bibrombenzoic acid. The nitrile gives the corresponding bibrom compound.

The Acids of the Colophonium of the Northern Pine: G. B. Frankforter and Clara Hillesheim.

The colophonium of the northern pine, instead of being, as Luce thinks, a single compound corresponding to the acid $C_{20}H_{30}O_2$ (abietic acid), is found to contain two acids, $C_{25}H_{38}O_5$ and $C_{38}H_{55}O_4$, which can be separated in the form of the ammonium salts by passing dry ammonia into a dry ethereal solution.

The Products of the Pitch of the Douglass Fir: G. B. Frankforter.

The butt of this tree is unusually rich in pitch, containing as high as 41.6 per cent. Of the pitch, 21 per cent. is turpentine. The latter has about the same boiling-point as that from the northern pine (150°) but differs from it in other properties. The turpentine and other products (pyroligneous acid, charcoal, etc.) from one such butt discarded by the lumbermen would have a value of $275.

This paper elicited much interesting discussion, especially with reference to the decrease in the production of turpentine in the south.

The Derivatives of Eugenol: G. B. Frankforter and Max Lands.

Eugenol forms a di-, tri- and tetra-bromide, in each of which all but one bromine atom enter the ring. In the case of chlorine derivatives all but *two* atoms enter the ring. A pentachloride was obtained, but not a pentabromide.

The Synthesis of β-Methyladipic Acid: W. A. Noyes and I. J. Cox.

This is the first synthesis of this compound from simple materials; by starting with levulinic acid, passing to the valerolactone, thence to γ-bromvaleric ester and synthesizing with cyan-acetic ester. α-β-dimethyladipic acid was also obtained.

Kansas Petroleum: Edward Bartow.

The field is comparatively new. Nineteen specimens collected from various parts of the state show the unusual variation of from 0.84 to 0.94 S. G., and a very low sulphur content. The bromine absorption is greatest for the heavy oils.

The Determination of Sulphur in Iron: Allen P. Ford and Ogden G. Willey.

A review of the methods in common use. Evolution methods usually give results entirely too low; oxidation methods give good results when worked by men who understand them. Bamber's method is recommended as being generally applicable, and deserving of more attention than it has received.

The Toxic Limits of Acid for Some Seedlings: Frank K. Cameron.

The results of these experiments show clearly that, owing to variations caused by the effects of light, temperature and the individual characters of plants, methods of this nature do not furnish safe conclusions in physical-chemical investigations.

On the Chemistry of the Colon Bacillus: Mary F. Leach. (By title.)

Nitrification in Arable Soils: W. A. Withers and G. S. Fraps. (By title.)

Analysis of Sea Water from Woods Hole, Mass.: A. P. Saunders.

Analysis of a small sample showed a total of solid constituents much lower than that usually given for Atlantic water.

In the discussion one of the members stated that another sample, drawn from the same locality but at a different time, was found by him to be of normal composition.

On the Relation of the Specific Gravity of Urine to the Solids Present: J. H. LONG. (By title.)

Cereal Foods: EDWARD GUDEMAN.

Analysis of a large number of samples from forty-three different manufacturers shows an average composition of

Ash	0.3
Fiber	0.5
Fat	0.7
Proteids	10.5
Carbohydrates (by difference)	88.0
	100.0

The Determination of Starch: W. A. NOYES and R. B. ARNOLD.

One of the objects of this work was to determine the best conditions for hydrolysis. One hour is the most favorable length of time with 0.5 per cent. acid at a temperature of 100°, or half an hour at 111°. Solutions giving 2 per cent. glucose give better results than those giving 0.5 per cent. glucose. In neutralizing the acid, it is much more desirable to stop a little short of the exact point rather than to overstep it. The greatest hydrolysis that could be obtained was 96–99 per cent. of the theoretical.

AUSTIN M. PATTERSON.

THE CASE FOR VACCINATION.

THE recent appearance of an admirable book entitled 'A Concise History of Smallpox and Vaccination in Europe,' by Edward J. Edwardes, has aroused new enthusiasm among British sanitarians in their efforts to undo the evil effects of the last Vaccination Act, which permitted the exemption of those persons known as 'conscientious objectors.' Its lesson is equally salutary in this country, where the vaccination laws are at present far too lax, and where the opponents of vaccination are conducting an active campaign for their repeal.

It should be frankly acknowledged that the responsibility incurred by the state in compelling its citizens to submit to the introduction of vaccine matter is a grave one. It is, in the first place, a serious infringement of personal liberty; and, in the second place, it must be owned that the process is attended with a certain, though an almost inappreciable, amount of danger. When arm-to-arm vaccination was practised, loathsome diseases were occasionally conveyed from one human being to another, but the general introduction of calf lymph now prevents the possibility of any such contingency. The transmission of tuberculosis, too, is effectually precluded by the tests to which the calves are submitted and by the addition to the lymph of glycerin. Erysipelas and tetanus, on the other hand, still sometimes follow vaccination. In a very large majority of cases these complications are due to secondary infection by the removal of dressings from the vaccination wound; in a few instances they have been traced to infection of the lymph itself. The extent of these dangers is, however, very slight. Dr. McFarland* in a careful review of all previous medical literature, was last year only able to find 95 cases of tetanus recorded as due to vaccination. The total number of deaths from erysipelas in the United States in 1900 was 2,861, and the total number from tetanus, 1,664, in a population of 75,994,575 with 1,039,094 deaths from all causes; and it can scarcely be claimed that any large proportion of this insignificant number was due to vaccination.

On the other hand, the benefits which

* 'Tetanus and Vaccination,' *Journal of Medical Research*, VII, 1902, p. 474.

vaccination has bestowed upon the human race may best be estimated by comparing the popular dread of smallpox prior to 1800 with the indifference with which it is regarded now. The 'Concise History,' referred to above, begins with a series of citations from the earliest medical writers, and we note that Rhazes, in the tenth century, attempted to explain how it happened that scarcely any one could escape the disease, and Mercurialis (born in 1530) said that 'almost every person must have it once.' In the eighteenth century statistics first became available from the works of Süssmilch, De la Condamine and others. The most important are those of Sweden, where in the period from 1774 to 1800 the annual smallpox death rate averaged 2,049 per million living and accounted for about one thirteenth of the total deaths from all causes. The statistics for Copenhagen, for London, for Berlin, for Liverpool and for Glasgow show in general the same relations, although in the latter city from 1783 to 1800 smallpox caused nearly one fifth of the total deaths. Nine tenths of the fatal cases of smallpox occurred in children under ten years of age.

Towards the end of the eighteenth century the struggle against this dread disease seemed almost hopeless. The practise of inoculation, which consisted in the introduction of actual smallpox matter under the skin, in order to induce a mild attack at a time when the body was in condition to meet it, had failed to effect any reduction in the general death rate. Just when it seemed that 'the continued raging of that pitiless plague' was the only prospect for mankind, Edward Jenner proved that an attack of the mild disease of cattle known as cowpox furnished protection against infection with the smallpox. He suggested 'vaccination' with cowpox material as a simple prophylactic against smallpox, and it is the introduction of this process which Dr. Edwardes calls 'the greatest sanitary fact which the world has ever known.' It was in June, 1798, that the physician of Gloucestershire published his 'Inquiry into the Causes and Effects of the Variolæ Vaccinæ,' and by 1801 it had been translated into Latin, German, French and Dutch. "As if an angel's trumpet had sounded over the earth, thus spread the good tidings into all lands, that a preventive had been found against the horrible disease smallpox, so long the scourge of humanity."

The protective effect of vaccination was at once established by actual experiment, and on a very large scale, by inoculating those who had been vaccinated with the true smallpox virus. Woodville stated in 1802 that of 7,500 persons vaccinated at the smallpox hospital, about one half had been since inoculated, without any effect being produced. Dr. Charles Creighton and Alfred Russel Wallace, the chief authorities of the 'anti-vaccinationists,' have attempted to discredit these tests by claiming that Woodville's lymph was contaminated and that the vaccination was really inoculation in itself. It is amusing to note that Wallace adopts this explanation on page 8 of his 'Vaccination a Delusion,' and on page 76 of the same book seriously maintains not only that vaccination exercises no protective effect, but that after a previous attack of smallpox 'instead of there being any immunity, there is really a somewhat increased susceptibility to a second attack.' It is odd that this startling fact was not noticed in the days when every one had the smallpox at least once! Woodville's account of his experiments shows that only a very small proportion of his cases—and those all prior to June, 1799—lay open to the objection mentioned above, and his conclusions were confirmed by similar tests, notably by 8,000 cases treated at the Medical College in Berlin. A small but

well-controlled experiment was carried out at Milton, Massachusetts, in 1809, with the same result.

The statistics of the early part of the nineteenth century furnish the first evidence of the effect of vaccination as applied upon a large scale. In Sweden, for example, the average annual smallpox rate per million was 1,914 from 1792 to 1801, 623 from 1802 to 1811, and 133 from 1812 to 1821. In Berlin the actual deaths from the disease amounted to 4,453 for the ten years 1782–91, 4,999 for the next decade, 2,955 for 1802–11, and 555 for 1812–22. The facts are brought out in a still more striking manner when the figures are plotted graphically, as was done for London from 1650 to 1900 by Dr. Newsholme.* Wallace published a similar diagram of the Swedish death rates which is alone enough to convince a candid student that something remarkably affected smallpox mortality about 1800; but he closed his eyes to its obvious teaching, and maintained that inasmuch as the curve fell off sharply from 1800 to 1803 before vaccination had become general, the decrease was due not to vaccination, but to 'sanitation.' It is certainly true that the deaths from smallpox decreased in the two or three years after 1800 without reference to vaccination, just as they had decreased periodically after every epidemic in the eighteenth century. But after every such previous decrease the mortality had risen again within five or ten years to another maximum. Why, after the decrease in 1803, did the death rate in Sweden remain at a minimum, never having risen since 1809 over 1,000 per million, and but four times over 500, while in 1801 it was 2,566, in 1800 5,126, in 1799 1,609, in 1796 1,963 and in 1795 2,956? There is not the smallest shred of evidence that 'sanitation' received any great and sudden impetus at exactly this time, unless sanitation be used to cover all the arts which tend toward 'the prevention of premature death.' In this wholly legitimate sense sanitation includes a number of prophylactic measures, each adapted to the diminution of a specific disease. When sanitation covered only isolation and quarantine it could control plague to a certain extent, but not smallpox, not typhoid fever, not diphtheria, not measles. When vaccination became a sanitary measure, sanitation conquered smallpox; but typhoid fever was not restricted until the day of water supplies and sewerage systems; diphtheria, not until the introduction of antitoxin. A fairly steady decrease in the general death rate has, indeed, occurred, due to a complex of factors not easily analyzed, but a sudden collapse such as that which affected the smallpox death rate after 1800 has never been manifest without a definite and tangible cause. That 'sanitation' has not affected the other zymotics to the same degree as smallpox has been graphically shown by A. F. Burridge in a recent publication.*

During the first quarter of the nineteenth century it was thought that a single vaccination in infancy would give indefinite protection against smallpox; but about 1830 this view began to lose ground. An adult population now existed, protected, not, as in other times, by previous attacks of smallpox, but only by the less potent effect of vaccination. Smallpox began, therefore, to recur, but modified in two notable respects. In the first place, its age incidence had shifted; whereas of 1,252 cases in three Prussian towns before vaccination began, 94.5 per cent. were under ten and not one over twenty years; of 1,677 cases in Wür-

* 'The Epidemiology of Smallpox in the Nineteenth Century,' *British Medical Journal*, July 5, 1902.

* 'Vaccination and the Act of 1898,' *Journal of the Institute of Actuaries*, October, 1902.

temberg after vaccination began, 18.4 per cent. only were under 10, and 42 per cent. over twenty years. So it is shown by Dr. Creighton in his article on 'Vaccination' in the 'Encyclopedia Britannica,' that, in England and Wales, about 1847, three fourths of the deaths occurred under five years, while in the eighties less than a quarter of the decedents were of this age. In the second place, beside this shifting of incidence, smallpox among the vaccinated proved much less fatal, even when it was contracted, than among the unvaccinated.

Although minor epidemics began to recur, smallpox in vaccinated countries was insignificant in amount until 1870–5, when a 'pandemic' swept over Europe which recalled the normal conditions of the prevaccination period. Considering the varying virulence of disease at different periods, and the fact that the importance of revaccination was not at all realized, such an epidemic was to be expected. The statistics for the early seventies have been used most dishonestly by the anti-vaccinationists in comparison with selected years of low mortality immediately after the introduction of vaccination in the attempt to show that no progress has been made. The worst year of this period in England and Sweden, however, showed a death rate about half the average yearly rate for the last quarter of the eighteenth century.

A comparison of the incidence of smallpox in this pandemic of 1870–5 upon different countries introduces the second class of evidence as to the value of vaccination. Thus Dr. Edwardes shows that for four countries having compulsory vaccination the average yearly smallpox death rate per million inhabitants was as follows: England, 361; Scotland, 314; Bavaria, 346; Sweden, 333. On the other hand, the rate for the same period was 953 in Prussia, 1,360 in Austria, 1,293 in Belgium and 958 in the Netherlands. All these countries had at this time no compulsory vaccination. The reverse has been affirmed in the case of Prussia, and Creighton, in the 'Encyclopedia Britannica,' states that revaccination 'has been more or less the law in Prussia since 1835,' and that 'Prussia was the best revaccinated country in Europe' in 1871. Dr. Edwardes discusses this question in some detail and quotes the official documents, which show explicitly that there existed in Prussia 'kein gesetzlicher Zwang zur Impfung.' Furthermore, the actual ratio of vaccination to births in Berlin is on record, and the percentage ranged from 29 to 58 between 1865 and 1870. In this city there were 6,326 smallpox deaths per million living in 1871!

The 'great pandemic' taught the lesson that both vaccination and revaccination were essential. In 1874 Germany enacted a law providing for compulsory vaccination within the second year and revaccination within the twelfth year. In Prussia the death rate, which had ranged from 95 to 2,624 per million from 1866 to 1874, dropped to 36 in 1875 and has been under 10 since 1885. For the empire as a whole, statistics, available only since 1886, show a rate of 4.2 in that year, decreasing to .5 in 1895 since which there has been annually less than one death per million. A comparison with the statistics of Austria graphically made by Dr. Edwardes furnishes as striking a proof that vaccination is the only kind of sanitation which affects smallpox as could well be desired. Before 1870 the two countries had about the same amount of smallpox; since 1875 that in Austria has increased and that in Prussia has practically disappeared. The only difference in conditions lies in the law of 1874.

Army statistics furnish striking confirmatory evidence. Thus Burridge* compares

* *Loc. cit.*

the Prussian army, in which revaccination on entrance has been compulsory since 1834, with the French army, where it has only been thoroughly carried out since 1888, and with the Austrian army, where there was no revaccination prior to 1886. The attack rate per 100,000 in 1875–85 was 4.7 in the Prussian army, 133.6 in the French army and 333.7 in the Austrian army. In the twenty-five years 1875–99 there were only two deaths from smallpox in the Prussian army, one in 1884 and one in 1898. The main point to notice is that these extraordinary results have been attained by a general revaccination of the whole population. Revaccination of only a single class in the community can not prevent the occurrence of occasional cases in that class, because in a large body of men there must always be some vaccinations which have not been successful. Thus the smallpox death rate in the English army with revaccination has ranged from zero to twenty-nine during the last forty years. Wallace in 'Vaccination a Delusion' made these figures look larger by raising them to rates per million (the basis of calculation being about 200,000 men), and then compared them with the rates for Ireland at the age period 15 to 45, which were only slightly higher from 1864 to 1894 (58 for the army, 65.8 for Ireland). Later he showed that the rate for 1873–94 was 37 in the army, 36.8 in the navy and 14.4 in the city of Leicester, and concluded that 'all the statements by which the public has been gulled for so many years as to the almost complete immunity of the revaccinated army and navy are absolutely false.' 'There is *no* immunity. They have *no* protection.' That is, Mr. Wallace selects one island in Europe where, largely from its isolation, smallpox happens not to have been serious, and one town in England where there has been almost no smallpox, and because these two places have had extraordinarily low death rates he maintains that the low army death rate, indicates no protection! Yet the figures were before him which showed that the average of the annual death rates in the navy, which was less than 32 from 1873 to 1899, had been 257 from 1860 to 1873; in 1873 an order was issued which provided for the vaccination of all recruits on joining.

The evidence derived from a comparison of the same country before and after the introduction of vaccination, and that based on the contrast at the same period between countries having different degrees of vaccination, have now been briefly considered. The third class of facts includes the 'direct evidence' of the incidence of smallpox upon persons in the same community protected and unprotected by vaccination. At Chemnitz in 1870–1, a special census was made to determine the condition of the population as regards vaccination, and it appeared that among those protected by vaccination or previous smallpox the death rate was 1.2 per 10,000, while in the unprotected it was 442.9. Similarly at Sheffield in 1887–8* the deaths per 10,000 were 7.5 among the vaccinated and 347.9 among the unvaccinated. An objection to statistics of this sort, made with some plausibility, is that the unvaccinated class includes a large proportion of children and of persons in feeble health or living under poor sanitary conditions. Regarding the first point, the Sheffield figures are conclusive. They are divided according to age periods and show that the rates per 10,000 living between fifteen and twenty years were, 7.0 in the vaccinated and 1,355.5 in the unvaccinated. Here no age difference comes in question. The second contention is met by the statistics collected by Körösi with reference to 14,678 persons dying from various causes in some Hungarian hospitals in 1886. The unvaccinated constituted 14

* Reviewed by Burridge, *loc. cit.*

per cent. of those who died from other diseases than smallpox and 81 per cent. of those who died from smallpox. Obviously it was the lack of vaccination which was at fault here, not feeble health nor unsanitary conditions. In opposition to these figures the anti-vaccinationists quote the experience of the city of Leicester, where since 1882 the number of vaccinations has steadily decreased, falling to less than two per cent. of the births in some recent years. Smallpox has been introduced a number of times (38 cases in 1892, 308 in 1893, 8 in 1894, 4 in 1895, 4 in 1901), but has not spread extensively, and the death rate has remained very low. The opponents of vaccination also quote, by way of contrast, statistics showing that an increasingly large proportion of hospital cases of smallpox occur among the vaccinated,* and that in epidemics the attack of an unvaccinated person is often not recorded for some time.† Facts of the last two classes have, of course, no special significance except to indicate the need for revaccination. No one now supposes that a single vaccination affords absolute permanent protection, and with the increase of vaccination there must naturally come an increase of cases among the vaccinated. The experience of Leicester, on the other hand, is certainly of interest. It shows that under certain conditions the dangers of neglected vaccination may for a time be braved with impunity by a considerable portion of the community. This has been so far accomplished by prompt reporting and strict isolation of cases, and, according to the chairman of the public health committee of the town by the fact that 'a handful of the population, including the medical men, sanitary staff, smallpox nurses, etc., are as well vaccinated in Leicester as in any other town, so that a cordon of protected persons can at once be drawn around any case of smallpox which may occur.'* It should be remembered, however, that the population of Leicester is still to some extent protected by the vaccinations carried out prior to the anti-vaccinationist agitation. Thus of the 358 persons attacked in 1892–5, 198 were returned as having been at some time vaccinated. The experience of Gloucester is ominous for the future of the 'Leicester experiment.' Prior to 1892–3, according to Dr. Edwardes, 'vaccination had been almost in abeyance, in Gloucester, and the inhabitants lived in a fools' paradise.' The result was an epidemic of 1,979 cases, with 434 deaths in a population of about 40,000, giving a death rate of 10,000 per million!

With regard to the smallpox occurring in persons once vaccinated, there are two points to notice. In the first place, the ratio of deaths to cases is far lower than among the unvaccinated. Thus at the Leipsic city hospital in 1870–2 99 died among 139 unvaccinated cases, 116 died among 1,504 vaccinated cases, and none among 13 revaccinated cases. Creighton and Wallace object to these statistics on the ground that the death rate thus apparent among the unvaccinated is obviously too high, because 'in pre-vaccination times the death rate (18.8 per cent.) was almost the same as it is now in the vaccinated and unvaccinated together' (Creighton. Now it is quite impossible to fix any such general fatality rate; the ratio of deaths to cases has varied within wide limits both in the eighteenth century and recently. In the second place, it has been claimed that the 'unvaccinated' death rate is swollen by the inclusion in that class, of children who escaped vaccination on account of feeble

* London smallpox hospital, 40 per cent. in 1838, $94^{6}/_{10}$ per cent. in 1879—Wallace.

† The first unvaccinated case was the 174th at Cologne in 1870, the 42d at Bonn in the same year, and the 225th at Liegnitz in 1871—Creighton.

* Windley, 'Leicester and Smallpox,' *Journal of State Medicine*, January, 1903, p. 21.

health. In the case of Gloucester, where vaccination has been so generally neglected, this objection can hardly apply. Yet at Gloucester in 1892–3, there were, under ten years of age, 26 attacks among the vaccinated with one death, and 680 attacks among the unvaccinated with 279 deaths. Statistics for six towns collected by the English Royal Commission of 1889 showed fatality rates of 35.4 among the unvaccinated and 5.2 among the vaccinated. The third objection made to the hospital statistics, namely, that the deaths of the unvaccinated class are unfairly increased by the inclusion of doubtful cases and those who have been vaccinated but show no scars, can scarcely apply to the commission's analyses. It will not, at any rate, have much weight, except with those who, like Mr. Wallace, believe that "in this matter of official and compulsory vaccination both doctors and government officials, however highly placed, however eminent, however honorable, are yet utterly untrustworthy."

A second important characteristic of the cases of smallpox in a once vaccinated population is that they are not only comparatively light, but that they affect the later periods of life; and this represents an important gain in the life capital of the community. During the epidemic of 1870–3, Bavaria, with compulsory vaccination, had 851 deaths under, and 3,520 deaths over, twenty years, while the Netherlands without compulsory vaccination had 14,048 deaths under twenty and 6,524 at higher ages. In the same great epidemic 71 per cent. of the deaths at Leicester and 64 per cent. of the death at Gloucester occurred under ten years. In London the percentage falling in this age class was 37, and in Warrington, with still more thorough vaccination, it was 22.5.

A single vaccination then greatly reduces the probability of an attack of smallpox, postpones it to a later period of life and renders it less dangerous if it does ensue. To ensure absolute protection revaccination is required; and its efficacy is well indicated by the experience of the Prussian army. In addition, one single bit of evidence may be adduced which is more striking, perhaps, than all the rest, the statistics of nurses in smallpox hospitals. These figures are of special interest because we have here a fairly large class of persons whose condition as to vaccination is accurately known, and who are uniformly exposed to the contagion of the disease; and the experience of two such communities is quoted by Dr. Edwardes. "During the epidemic of 1871 there were 110 persons engaged in the Homerton Fever Hospital, in attendance on the smallpox sick; all these, with two exceptions, were revaccinated, and all but these two escaped smallpox." "Of 734 nurses and attendants in the Metropolitan Asylums Board Hospitals, 79 were survivors from smallpox attack—they escaped infection; 645 were revaccinated on entrance—they all escaped; 10 were not revaccinated, and the whole 10 took smallpox."

If statistics ever proved anything those quoted above prove the protective influence of vaccination. If any fact in science is certain, it is certain that a successful vaccination absolutely prevents smallpox for a period of some seven to ten years, that after that period it renders the disease less fatal, and that its complete protective effect may be renewed by revaccination. The conclusion is obvious, not only that the state should oblige primary vaccination, but, in the words of a minority of the British Royal Commission, that 'a second vaccination, at the age of twelve, ought to be made compulsory.'

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*ON USES OF A DRAWING BOARD AND SCALES IN TRIGONOMETRY AND NAVIGATION.**

It may seem a little strange that any one should think it worth while to call special attention to a drawing board and scales as a means of solving spherical triangles and a few somewhat similar problems. For, accurate results can be obtained through simple computations and rough results by aid of suitable diagrams composed chiefly of curve systems. Such, for instance, are many cartographic projections of the great and small circles of a hemisphere. But where results reliable to about 5′ of arc or angle are required, and where computation is to be altogether dispensed with, it seems to me that the methods about to be described certainly possess merits which have not heretofore been fully recognized.

* Delivered before the Philosophical Society of Washington, January 31, 1903.

Suppose the dimensions of the drawing board to be about 22 by 40 inches. Let it be trimmed, as it were, with a metallic border three margins of which are divided into degrees and fractions of degrees so as to form a large rectangular protractor, as sketched in Fig. 1. The border of the fourth side may be graduated uniformly from its center, where is situated a pivot or pin about which the scales may revolve.

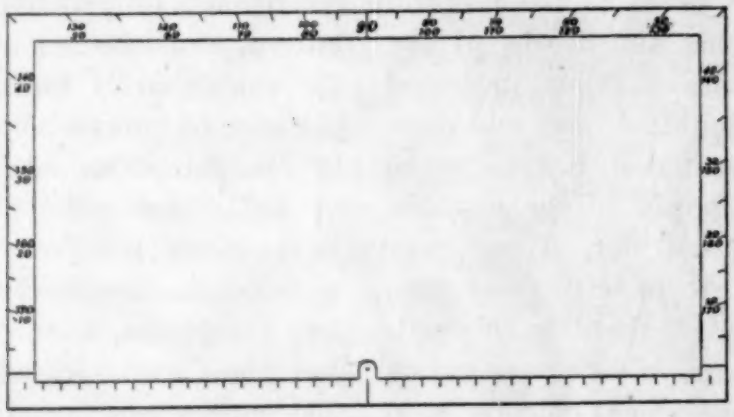

Fig. 1.

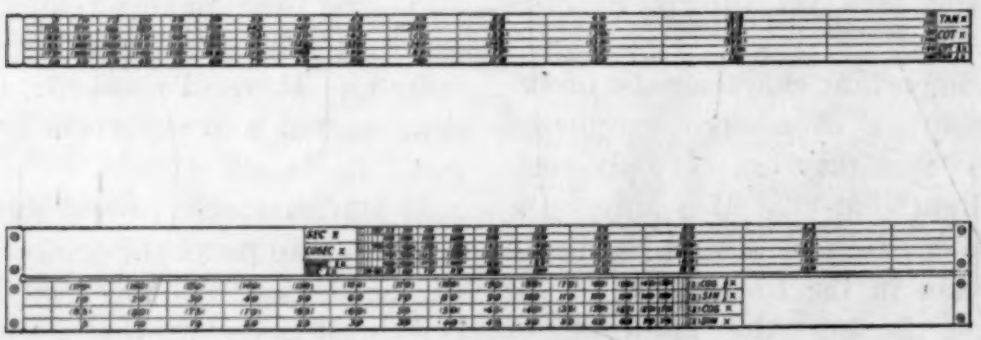

Fig. 2.

The scales to be used in the solution of spherical triangles are scales of sines, cosines, tangents, etc., like those shown in Fig. 2, but having, of course, much finer graduations along the edges. For use upon a 20-by-40-inch board, the extreme length of the scales should be about 30 inches. For increasing the size of the divisions, we shall suppose sines and cosines to have been multiplied by 2 in constructing the scales. In addition to trigonometrical scales it is supposed that we have several

uniformly graduated scales, which are especially useful in problems involving plane trigonometry, and a set of scales of meridional parts for various latitudes, each scale representing, say, 10 degrees of latitude. In all cases the scales must be straight and beveled on their edges. It is supposed that we have also a T-square with a uniformly graduated blade.

RIGHT SPHERICAL TRIANGLES.

By means of the board and scales we can find such products as cot $b \times \tan c$ by laying off cot b, according to the scale labeled cot x, along the base line of the protractor. Let a straight edge, turning about the

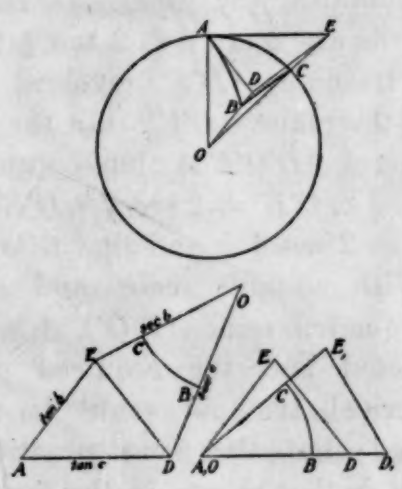

FIG. 3.

pivot, be directed toward value c on the margin. The T-square shows the line extending from the point where cot b was laid off to the straight edge. The distance is the product cot $b \times \tan c$. By reading this distance on a scale cos x, or double this distance on a scale 2 cos x we obtain a certain angle which is the value of the angle A of a triangle right-angled at B. Napier's rules enable one to see at a glance what product is required and how it is to be read. Where tangents and cotangents are involved, the application of this method is, of course, somewhat restricted on account of the length of the scales.

SINE RATIOS IN SPHERICAL TRIANGLES.

If two of the three given parts of a triangle are opposites, the unknown part opposite the third given part becomes known through the equality of the sine ratios; viz.,

$$\sin A : \sin a = \sin B : \sin b = \sin C : \sin c,$$

or

$$\sin A \sin b = \sin B \sin a, \text{ etc.}$$

The process of mechanically solving such problems can be illustrated by taking a particular case or problem; given A, a, B to find b.

Find a on the scale labeled 2 sin x and direct the scale (pivoted to the board) towards B as found on the margin of the

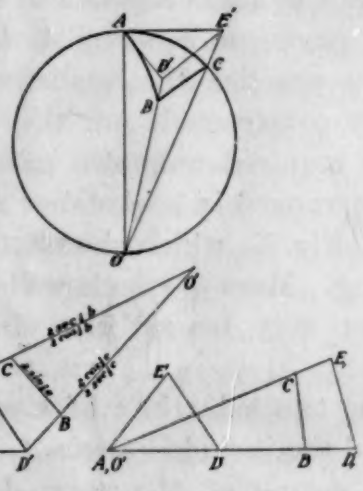

FIG. 4.

board; this locates a certain point. Next direct the scale towards A. Find on the scale as now directed a second point whose altitude is the same as that of the first. This is done by sliding the graduated T-square. The reading of the second point on the scale labeled 2 sin x (still pivoted to the board) is the required side b.

RELATION BETWEEN THE THREE SIDES AND ONE ANGLE.

In treating the problem—given the three sides to find an angle, or given two sides and the included angle to find the remaining side—it is important to consider two

methods, or constructions, analogous, but differing somewhat from each other. The first may be referred to as the gnomonic method, and the second as the sterographic.

Let ABC, Fig. 3, be the spherical triangle. A plane tangent to the sphere at A contains the lines AD, AE, whose lengths are tan c, tan b. Imagine the triangle ODE revolved about DE into the plane ADE. In the plane quadrilateral $ADOEA$ thus obtained, $OD = \sec c$, $OE = \sec b$, $OB = OC = 1$; also arc $BC = a$, which measures the angle O.

Assume now that we have scales of tangents and secants. The quadrilateral constructed by aid of such scales and a protractor gives the angle A when a, b, c are the known parts, or a when A, b, c are known. In practice the quadrilateral is not actually constructed; but the work of finding the required unknown part of the triangle is arranged in accordance with the diagram in Fig. 3, which shows A and O as coinciding. More particulars about this arrangement may be gathered from the example.

Given the two sides b, c of a spherical triangle and the included angle A, find the side a by means of the above-described apparatus.

Lay off with the scale of tangents when pivoted to the drawing board a distance along the initial direction which reads c; this fixes on the board the point D. Lay off towards A, as found on the margin of the board, a distance which reads b on the tangent scale; this fixes on the board the point E. On beam compasses set the distance DE, or mark it off upon a strip of paper. Next remove the scale of tangents and pivot to the board the scale of secants. Lay off on the secant scale, and beyond D, a distance which reads c; this fixes the point D_1. With the beam compasses centered at D_1, describe an arc. Lay off on the secant scale, still pivoted to the board (and revolving about O) a distance which reads b and note where it intersects the arc just drawn; this fixes the point E_1. The angle read off on the margin of the board is the side a.

The same construction taken in a slightly different order serves for finding A where a, b, c are the known parts.

We now take up the stereographic method. The problems to be considered are the same as those to which the gnomonic method applies. The advantage of the stereographic method lies in the fact that tan $\frac{1}{2} x$ does not approach infinity until x approaches 180°.

A plane tangent to the sphere at A, Fig. 4, contains the lines AD', AE' whose lengths are 2 tan $\frac{1}{2} c$, 2 tan $\frac{1}{2} b$. Imagine the triangle $O'D'E'$ revolved about $D'E'$ into the plane $AD'E'$. In the plane quadrilateral $AD'O'E'A$ thus obtained, $O'D' = 2 \sec \frac{1}{2} c$, $O'E' = 2 \sec \frac{1}{2} b$, $O'B = 2 \cos \frac{1}{2} c$, $O'C = 2 \cos \frac{1}{2} b$ and line $BC = 2 \sin \frac{1}{2} a$.

With suitable scales and a protractor the quadrilateral $AD'O'E'A$ could be constructed and the required part of the spherical triangle could be thus determined; but the more practical arrangement is that shown in the figure where O' is made to fall upon A. Moreover, it is convenient to omit the factor 2 before tangents and secants.

Given b, c, A to find a by means of the above-described apparatus.

Lay off by means of the scale labeled tan $\frac{1}{2} x$, pivoted to the drawing board, a distance along the initial direction which reads c; this fixes a point D'. Lay off on this scale now directed towards A, as found on the margin of the board, a distance which reads b; this fixes on the board a point E'. On beam compasses set the distance $D'E'$, or mark it off upon a strip of paper. Next remove the tan $\frac{1}{2} x$ scale and pivot to the board the double scale shown in Fig. 2. Lay off with the

scale labeled sec $\frac{1}{2}x$, and beyond D', a distance which reads c; this fixes a point D_1'. With the beam compasses centered at D_1', describe an arc. Lay off on the sec $\frac{1}{2}x$ scale, still pivoted to the board (and revolving about O'), a distance which reads b and note where it intersects the arc just drawn; this fixes a point E_1'. Along the directions AD_1' and AE_1' locate the points B, C by laying off distances which read c and b upon the scale labeled 2 cos $\frac{1}{2}x$. The reading of the distance BC upon the scale labeled 2 sin $\frac{1}{2}x$ is the value of the side a.

The same construction taken in a slightly different order serves for finding A when a, b, c are the known parts.

In passing, it may be well to note that plane trigonometry applied to the triangles ADE and OED gives

$$\overline{DE}^2 = \overline{AD}^2 + \overline{AE}^2 - 2\overline{AD}\,\overline{AE}\cos A$$

$$= \overline{OD}^2 + \overline{OE}^2 - 2\overline{OD}\,\overline{OE}\cos a$$

$$\therefore \tan^2 c + \tan^2 b - 2\tan c \tan b \cos A = \sec^2 c + \sec^2 b - 2\sec c \sec b \cos a.$$

Noting that $\sec^2 = 1 + \tan^2$ and multiplying through by cos b cos c, we have, after transposing,

$$\cos a = \cos b \cos c + \sin b \sin c \cos A.$$

The same equation follows from the second method by noting that

$$\overline{D'E'}^2 = \overline{AD'}^2 + \overline{AE'}^2 - 2\overline{AD'}\,\overline{AE'}\cos A;$$

and

$$\overline{D'E'} : \overline{BC} = \sec \tfrac{1}{2}c : \cos \tfrac{1}{2}b$$

where $\overline{BC} = 2 \sin \frac{1}{2}a$, and later on that

$$2\sin^2 \tfrac{1}{2}a = 1 - \cos a,\ 2\cos^2 \tfrac{1}{2}a = 1 + \cos a.$$

POLAR TRIANGLES.

Cases analogous to any of the above, but having sides and angles interchanged throughout, can be solved by the foregoing methods provided we first subtract all known parts from 180°, interchanging capital and small letters, and then after having solved this polar triangle, subtract the parts from 180°, and finally interchange the capital and small letters.

APPLICATIONS.

The methods already described may be used to advantage in some classes of plane-table work. To obtain the azimuth of the sun by one mechanical solution of the triangle, it is necessary that the telescope of the alidade be supplied with a vertical circle. The direction of the sun could be ascertained by means of a good watch, but the spherical triangle would then have to be solved for two of its parts.

The azimuth and hour angle of the sun or other heavenly body can be obtained from an observed altitude with sufficient accuracy for enabling one to lay down a Sumner line at the assumed or dead-reckoning latitude, and for ascertaining the variation of the magnetic needle at sea.

Tables of sunrise and sunset can be computed with great facility by means of the stereographic method. In fact, the true zenith distance (BC) of the rising or setting body is a constant for all latitudes and dates. The distance between pole and zenith at any particular latitude is constant for all dates. (That is, D', B and D_1' are fixed points for a given latitude, and about B, the zenith, a circle can be described with 2 sin $\frac{1}{2}a$ as radius.) Since the polar distance of sun or moon never exceeds 120°, scales of moderate length will suffice for all possible cases.

Consider now the question of great circle sailing. The distance and initial course between two points specified by their latitudes and longitudes require the solution for two parts of a triangle whose given parts are two sides and the included angle. The longitude and latitude of the

vertex involve the solution of a right-angled triangle for two of its parts.

Since it seems to be almost certain that a proposed great circle track will in reality be sailed as a series of rhumb lines each terminating in or near the great circle, the methods of Mercator sailing will still be found useful. By aid of a set of meridional scales, problems in Mercator sailing can be worked with great facility. For, the board, the uniformly divided scales, and the T-square constitute an ordinary traverse table, and the departure is readily converted into difference of longitude through the equation

$$\text{Diff. long.} = \frac{\text{merid. diff. lat.}}{\text{true diff. lat.}} \times \text{departure.}$$

To do this, suppose the meridional difference of latitude to be laid off upon a uniform scale rotating about the pin or pivot. Let the true difference be laid off along, or parallel to, the initial line. Rotate the former scale until the T-square indicates that the point representing meridional difference is directly above that representing true difference. Now slide the T-square along until a point in the initial line is reached which denotes the value of the departure. The reading of the rotated scale directly above this point is the difference of longitude.

In conclusion, it should be said that the aim has been to use the drawing board proper merely as a surface upon which to locate points or lines temporarily, the accuracy of the work depending upon the fact that the scales and border of the board are not subject to any considerable atmospheric or temperature changes. R. A. Harris.

SCIENTIFIC BOOKS.

Zoology: Descriptive and Practical. By Buel P. Colton, A.M. Boston, D. C. Heath & Co. 1903. Part I., Descriptive, pp. x + 375. Part II., Practical, pp. xvii + 204.

Colton's 'Practical Zoology,' which was published seventeen years ago, did excellent pioneer work as a laboratory guide for secondary schools. This useful hand-book, revised and amplified, now appears in connection with an excellent descriptive zoology.

In the latter the author introduces each of the larger groups of animals by a description of a typical example, treating of its morphological and physiological characteristics and paying especial attention to its habitat, movements, senses, capture of prey, taking of food and manner of self defense.

Naturally, Arthropods, and particularly Insects, have a prominent place at the beginning, followed by a brief account of the Annulata, a somewhat longer description of the Mollusca and an extended discussion of the Chordata. Thereupon the Protozoa, Porifera, Cœlenterata, Echinodermata, Platyhelminthes, Trochelminthes and Molluscoidea are taken up in the order given. This is an excellent practical arrangement on the whole, though it might have been still better to have placed the Annulata and Echinodermata last and thus have preserved the ascending order throughout each of the two sections, for the sake of avoiding those misconceptions which are wont to arise in the mind of the beginner, to whom position in a text-book has a profound significance.

The strongest feature of the book is its broad treatment of animal life, in other words, its natural history. The author has a keen sense of what is interesting. His style is simple and direct, and the book is thoroughly readable.

The author did not cease to do pioneer work when he published his 'Practical Zoology' seventeen years ago. In the present book he makes free use of 'tho,' 'thru,' 'thoro' and their various compounds, while 'celom,' 'cecum,' 'hemal' and a few other words have been stripped of superfluous letters. He does not attempt to set right names like Amœba, which are apparently protected by their Latin form, but one is surprised that 'cœlenterates,' 'diaphragm' and a few other terms should not have been pruned. Spelling reform has much in its favor, and it must be introduced

by such gradual changes that a conservative public may not be offended. In the present instance the author's zeal does not seem to have led him to the point of giving offense, even though he may have laid himself open to the charge of inconsistency.

The book is comparatively free from minor errors or infelicities. On page 90, the skin of the earthworm is said to consist of three layers, the cuticle and epidermis, no mention being made of the derma. The cœlomic epithelium is omitted in the enumeration of the coats of the body wall. The description of the papulæ of the starfish as 'holes thru the aboral wall from which extend slender projections of the thin, soft lining membrane of the body cavity' needs considerable revision. The term 'digestive tube' is used when the cavity of the digestive tube, not its walls, is meant. The statement that in the echinoderms the digestive tube is 'distinct from the body cavity' is not very illuminating as it stands.

The illustrations are mostly well chosen, and about forty of them are original. It is unfortunate that greater care was not given to matters of detail in some of the original diagrams; thus the oviducts in the snake and the oviduct in the pigeon are each incorrectly represented as opening in front directly into the cavity of the ovary.

The capital press work of the descriptive part contributes in no small degree to the general excellence of the book.

Part II., on 'Practical Zoology,' is a great improvement over the original laboratory guide with which teachers in secondary schools are familiar. Full directions are given for the observation of living animals in the field and in captivity.

This part, however, might be made much stronger in respect to its teaching of morphology, without greatly increasing its size. For example, the attention of the student is not called to the cœlom of the earthworm either in connection with the dissection or in the study of the cross-section; and the term body-cavity is used loosely to apply to the enteric cavity in Hydra and to the cœlom in vertebrates. The directions for the study of the brain, particularly that of the rabbit, are exceedingly inadequate. We are told that the optic nerves 'directly enter the cerebrum'; and both diencephalon and midbrain are ignored. While this is in line with the popular notion that the brain consists of only two parts, it is not the sort of teaching that ought to find place even in a very elementary text-book. This part is remarkably free, however, from positive errors, and can be heartily recommended as a laboratory guide for secondary schools; the descriptive part is an elementary text-book of unusual merit.

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DISCUSSION AND CORRESPONDENCE.

METEOROLOGICAL OBSERVATIONS WITH KITES AT SEA.

TO THE EDITOR OF SCIENCE: Under the titles 'A New Field for Kites in Meteorology' and the above there were described in Vol. XIV. of SCIENCE experiments by the writer and his assistants of flying kites in calm weather from a tug-boat and from a transatlantic steamship. The demonstration that meteorological observations might be obtained at high altitudes, independently of the natural wind, over the greater portion of the globe and where no observations had been possible before, attracted the immediate attention of European meteorologists. The following brief accounts show that their application of this new method of meteorological research has been both extensive and successful.

The first to repeat the pioneer experiments of the late Mr. Sweetland and the writer during their voyage across the North Atlantic in 1901 were Messrs. Berson and Elias, of the Prussian Meteorological Institute, who, last August, made a voyage from Germany to Spitzbergen and back, achieving satisfactory results with their kites. Meanwhile Professor Köppen, of the Deutsche Seewarte, carried out analogous experiments on the Baltic Sea. About the same time, Mr. Dines, aided by grants from the Royal Meteorological Society and the British Association, employed

a small steamer for kite-flying off the west coast of Scotland, in connection with a fixed station on land. The vessel could be manœuvered at will, as in the writer's initial experiment in Massachusetts Bay, and the results published show that 38 records of the various elements were obtained at an average height of 6,000 feet, and that once an altitude of nearly 15,000 feet was reached, although, in this case, the upper kites and the recording instrument were lost, owing to breakage of the wire.

It is probably known to many of your readers that at several stations in Europe, and on Blue Hill in this country, balloon ascensions or kite-flights are made upon a specified day every month, in order to obtain meteorological data in the upper atmosphere simultaneously over a large region. In order to be independent of the natural wind, which is frequently unsuited to kite-flying, and to accelerate or diminish it as required, meteorological kites have recently been flown from steamboats on Lake Constance by Count von Zeppelin and Professor Hergesell on some of these term-days. Similar experiments upon the smaller lakes of Prussia and Russia have also shown that kites may be rendered nearly independent of the wind even in the interior of the continents.

A most remarkable campaign has been conducted by M. Teisserenc de Bort, who, with the aid of Scandinavian colleagues, established last summer a kite-flying station in Jutland, Denmark, where aerial soundings were made day and night, wind permitting, during nine months. After the termination of this work the apparatus was transferred to a Danish gunboat, and on a cruise in the Baltic Sea the following extraordinary results, which have just been communicated by the director, were obtained on five consecutive days: April 22, at an altitude of 9,450 feet a temperature of —14.°8 F. was found; April 23, at 13,500 feet, the temperature was 9.°1; April 24, at 4,660 feet, 38.°3. On April 25, an altitude of 19,360 feet, which is probably the greatest height ever reached by a kite, was exceeded, and an instrument on the lower portion of the wire, at a height of 7,415 feet, recorded 24.°4. In this flight the total length of the wire was 38,000 feet, and the upper 4,000 feet, with the highest registering instrument, broke away, but were recovered. On the morning of April 26 an altitude of 8,140 feet, with a temperature of 15.°2, was obtained and in the afternoon 13,320 feet with a temperature of 3.°2. Since the gunboat steamed only nine and a half knots, the kites could not be flown when there was a complete absence of wind.

These various experiments amply prove the practicability of the writer's project to investigate the atmospheric strata lying above the doldrums and trade-winds, by means of kites flown from a specially chartered steamship. This plan, which was outlined in Science, received the approval of the International Aeronautical Congress at Berlin last year, and an application for a grant to aid its execution is now before the trustees of the Carnegie Institution. Although the German, British and Scottish antarctic expeditions were equipped with meteorological kites, the reports received confirm the prediction of the writer that little use would be made of them during the voyages southward. On the vessel which the Baltimore Geographical Society sent last month to the Bahamas, Dr. Fassig, of the Weather Bureau, expected to fly kites, but, owing to the substitution of a schooner for a steamer, this could not well be done and, therefore, the kites were probably flown only at Nassau. It is to be hoped that Dr. Fassig has obtained observations of temperature and humidity in the trade-winds which, even if he did not succeed in getting through, owing to their becoming light above, will be of considerable value. These observations might serve as a starting point for the work of the expedition proposed by the writer, which would proceed across the equator and be capable of sounding the atmosphere to the height of four miles, notwithstanding the fact that winds either too light or too strong for the kites may be encountered when the steamer is stationary.

A. Lawrence Rotch.

Blue Hill Meteorological Observatory,
July 8, 1903.

SHORTER ARTICLES.

CRYSTALS OF OXALATE OF LIME IN PLANTS.

Agricultural and physiological chemists are generally of the opinion that one of the functions of lime in the nutrition of plants is to form an insoluble compound with oxalic acid and thus neutralize any toxic effect which this acid might have upon the plant tissues. Whether this theory is true or not it is quite certain that crystals of calcium oxalate are found in many plant tissues, while in some, especially those developing large quantities of organic acids, they are very abundant. A remarkable occurrence of such crystals has lately been disclosed by an investigation carried on in this bureau by Mr. B. J. Howard, chemical microscopist and histologist, on a sample of *Colocasia antiquorum*, the well-known taro, one of the principal food staples of Polynesia, brought to the bureau by Mr. W. E. Safford, assistant curator of the Bureau of Plant Industry, who is preparing a report on the economic plants of Polynesia. Mr. Safford stated that the intense burning and pricking sensation which is experienced on chewing parts of certain plants, such as the Indian turnip (*Arisæma triphyllum*) and the plant above mentioned, has been alleged to be due to the action of the acicular crystals of calcium oxalate which are said to exist in immense numbers, and which attach themselves to and enter, at least superficially, the mucous and other membranes with which they come in contact. I requested Mr. Howard to make a micro-chemical examination of this sample in order to determine whether or not such crystals were present. A simple trituration of the parts of the plant, as, for instance, a leaf, in water until a pulp is produced, is a sufficient preparation. A small portion of the pulp is placed upon a glass slide, a drop of water added (or water and glycerine) covered with a glass, and placed in the field of the microscope. When thus prepared, numerous very oblate spheroidal bodies were discovered within which were enclosed fine needles in a dense bundle. Some of these acicular and very long delicate crystals were dissolved in hydrochloric acid and were found to produce a precipitate of oxalate of lime when made alkaline by ammonia. The crystals of oxalate of lime produced in this way were not acicular as in the original case, but tetrahedral. While examining the field of the microscope, Mr. Howard observed in the case of one of the oblate spheroids the projection of these crystals into the ambient liquid with what seemed to be a considerable degree of force. This observation was so interesting that I requested Mr. Howard to prepare another portion of the material and see if the phenomenon be repeated. I first examined carefully the field of the microscope as prepared, but found no crystals, but a large number of spheroids above mentioned in which the bundles of long acicular crystals could be easily distinguished. These were surrounded by a membrane of quite uniform thickness, apparently of a cellular nature and probably consisting mostly of a cellulose—in other words, the crystals seemed to be encysted. During a period of observation of from five to ten minutes I did not notice the recurrence of the phenomena above described. Mr. Howard then observed the field in the microscope, and in a few minutes he said that one of the bombs had begun to discharge its projectiles. I immediately took Mr. Howard's place at the microscope and saw, for a period of five or ten minutes, a most remarkable display. Continual discharges were made from this bomb, the ends of the arrows spreading out as they emerged in groups of from four to ten. As these groups were finally separated from the bombs, they were discharged with considerable velocity into the ambient liquid, the bomb itself suffering a corresponding recoil. I did not keep an accurate account of the discharges made; but I would say that they would average not less than two per minute. Sometimes one or two needles only would be discharged, projecting rapidly, and then leaving the bomb finally with a sharp advance. At other times, as before mentioned, groups of from four to ten arrows would discharge at once. The field of vision in the vicinity of the bomb became partly covered with these long crystals, but the supply within the bomb did not seem to diminish materially. There

must have been many hundreds of these arrows in one single spheroid. Perhaps an oblate spheroid is not the best description of one of these masses. They resemble more a long capsule used in pharmacy with rather sharper ends, or the cigar-shaped balloon of an airship.

In looking for the cause of the discharge I suggested to Mr. Howard that it might be due to the contraction of the cell walls, due either to pressure of the cover glass or to drying. Mr. Howard suggested, and it is a very plausible reason, that it might be osmotic pressure due to the presence of certain mineral substances in the mother liquor. He proposes to test this theory experimentally by making a salt solution for mounting, to imitate, if possible, that within the bomb and thus to exclude osmotic pressure. Presumably, when left in the tissues of the plant the crystals are not discharged; at least, in the preparation which was under observation no free crystals were found until the bomb began to discharge the missiles; as the plant would grow older, however, and the osmotic conditions change, or the cell walls begin to dry, the discharges would begin to take place in the tissues of the plant. These bombs are bundles of crystals and are, of course, exceedingly small, and most of them would doubtless escape rupture during mastication, but a sufficient amount of them would discharge their arrows to account for the pricking sensations attending the mastication of this material.

Mr. Safford, who, while connected with the navy, spent some time among the Polynesians and made a study of the foods in common use, says that this plant is one of the principal food staples of the Polynesians and other Pacific islanders, who eat both the starchy rootstock, either baked or made into paste, and the young leaves which taste not unlike asparagus.

If the plant is not thoroughly cooked its acrid qualities remain in some degree. If thoroughly cooked they are destroyed. It is interesting to note that in cases where the leaves are chewed, either fresh or dried, the stinging sensation is not perceived until a few moments afterward, and in many cases it is not until the taro root has been eaten that the prickling sensation in the lining of the mouth and throat shows that it has not been thoroughly cooked.

Alocasia indica, a plant closely allied to the taro plant, is so acrid that the Pacific islanders resort to it only in cases of great scarcity of food. The disagreeable effects caused by these plants seem to be confined to the temporary prickling sensation of the mouth and throat. They are undoubtedly nutritious and are held in high esteem by the natives. The acrid principle in the manioc or cassava is at least partly due to the presence of hydrocyanic acid, and this is removed by cooking. It will be interesting to see if any of this poisonous acid is also found in the taro and *Alocasia indica*.

In the case of an Indian turnip lately examined by Mr. Howard, the capsules were found to be somewhat smaller and the crystals larger and shorter than those described. A drop of the sap of the taro, which was shown under the microscope to contain no crystals, did not produce a burning sensation when placed in the mouth. On the contrary, a drop of the juice of the Indian turnip which carried free crystals was quite active in producing the characteristic symptoms. These facts are additional evidence to support the theory at first mentioned.

While not yet fully established, there is presumptive evidence that the pricking and burning sensation experienced in masticating materials of this kind is mostly of mechanical origin.

H. W. Wiley.

THE SEMINAR METHOD IN NATURAL SCIENCES, ESPECIALLY IN ZOOLOGY.

Any one who has watched, for a number of years, the announcements of the lectures at German universities, will have noticed that the so-called 'Seminar-Ubungen,' 'Colloquia,' or 'Besprechungen,' and 'Wissenschaftlichen Gesellschaften' have been extended more and more, and now take often an important place among the courses offered by a department.

The desire of reaching the student better

or, more properly, of making a more lasting impression on his mind than is possible through the mere words of lectures was, of course, felt everywhere. Instead of being merely receptive, taking in lectures, and comparing them, at best, perhaps with some books, the student was to be put face to face with the problem, to be forced to be reproductive, and thus to be led to become productive.

The strong sympathy for the perfect liberty of the university student throughout Germany discriminated against any attempt at introducing school methods into the university. The natural sciences, of course, had developed their demonstration and laboratory methods. The other sciences, which are grouped together as mental sciences (the German 'Geisteswissenschaften'), then tried also to introduce practical studies. Thus the seminar was developed and has gained in favor ever since. To-day we find 'Seminarübungen' offered in the different branches of theological studies, jurisprudence, history, philology, philosophy, etc.

The word 'seminar,' as it is used at the universities to-day, means, in the first place, a room provided with tables for the students and containing the department library, especially the periodicals, models, charts and other study collections. The students become members of the seminar by paying a small 'contribution.' They receive a key to the seminar rooms, a table and the right of access to, and use of, all the books and apparatus of the institution. Each seminar has a janitor to keep things in order, and is open from 8 A.M. to 9 P.M. (for members only, of course). The students spend hours between lectures there, study, write their theses, etc. One of the finest and best equipped seminars of which I ever was a member is the geographical seminar of Professor Ratzel at Leipzig. It consists of four rooms; one is the study of the professor, one the study of his assistant, one is a large room which contains a very fine department library and the tables for the students, and in the fourth large, hall-like room all the numerous charts and maps, models and instruments are kept and may be used on special large tables. The fact that all but this last room open on an inner court of the university buildings shuts out the noise of the street, and the entire wing, being constructed to accommodate nothing but seminars on all its floors, is out of reach of the buzz of the students going to and coming from their lectures.

Besides the institution itself, the word seminar means also the 'colloquia' (or 'Besprechungen') and practical courses which are given in the institution and which are also called 'Seminarübungen' or simply 'Ubungen.'

The term 'Gesellschaft,' as used by certain professors, means similar work, but on the whole it corresponds more to what we call zoological club or journal club in America.

The chief advantage of all these courses is that they bring the student in closer contact with the professor. From my own experience I know how much benefit may be derived from this method. While studying over there I was fortunate enough to be admitted, for a number of semesters, to the seminar conducted by the professor of history of art (Professor Schmarsow, of Leipzig). Although these studies were out of my line, I gained so much there, and got such an insight into the methods and ways of thinking of the representatives of the mental sciences, that I have always been extremely thankful for this chance.

Quite recently seminars and seminarübungen have also been offered in the natural sciences, more especially in zoology and botany, at some of the German universities. The mental sciences, which have found so many of our methods useful for their purposes, render thus, as it were, their thanks and offer us a method which they have developed and which we might accept, perhaps, with some advantage.

The 'Practica' and 'Praktischen Ubungen' in natural sciences do not concern us here, they are simply laboratory courses independent of, or, better, separated from, the lectures. In many, perhaps most, cases the laboratory methods for the first years of study are decidedly better in this country. There are better instruments and apparatus at hand,

better laboratory and library facilities, more and better material to work with, and more personal instruction is given here than in Germany. The foreign methods—this may, perhaps, be said in their favor—make students more independent, because there are no strict directions to be followed, no note-books to be compiled. The professor gives you the animal, tells you the literature, and leaves you. You have to find out all about the creature yourself, and when he comes back you have to demonstrate to him what you have found. If that is not enough, he simply tells you that you have to keep on and he does not allow you to pass on to anything else until you have found and seen and drawn, yourself, everything that you can be expected to find. This method, of course, would not work with large classes. It can be used over there because the classes in zoology, botany and so on are always small and, besides, the students are more mature when they enter the university. Each professor has his individual laboratory method, which is just as good as anybody else's and which he does not care to publish. The general courses are always given by the head professor, because he is expected to have done so much special work that he is able to generalize. Thus he develops his methods from his special studies and carries them out, or has them carried out by his assistants. The younger 'docents,' on the other hand, give the advanced and special courses. They begin with their own specialties, widening their programs gradually, and thus develop special methods in their laboratory courses in their turn.

Where the classes are larger, and especially in the beginners' courses, the methods are often stricter and more school-like. In chemistry, physics, histology, etc., the methods are similar to those used in this country.

Let us see now what we may expect from a seminar in zoology, and in how many different ways it may be conducted.

I. There is, first, the simple method of reading a book with the students. This may be used as an introduction for beginners. Let us take, for instance, Darwin's 'Origin of Species.' The students read a chapter at home; at the seminar, the chapter will be discussed and questions asked. The animals mentioned by Darwin will be exhibited as specimens or, at least, in good pictures. In connection with these animals a great many questions will come up, and the instructor may ask a member to look up some special literature and report the next time. Of course the instructor has his plan, which he follows, and in harmony with which he directs all the discussions. Here and there he will have to interpret and show that certain views can not be held any longer, or that some authority, perhaps himself, does not agree with Darwin, and why. Thus the students are given several points of view on the subject and led to independent thinking.

In this way, without school-like recitations, the whole book will be gone through. While, in a course of lectures, the students will get the general idea of evolution, the seminar will show them how such an eminent investigator as Darwin worked and reasoned, and will give them a lot of detailed knowledge, and many inspiring thoughts for their own work besides.

II. Another seminar would be, for instance, 'Darwin, His Life and Work.' The instructor gives an outline of Darwin's life; each member takes one book or certain chapters, reads them and prepares a report for the meeting. Discussions, explanations and demonstrations follow. If the class is small, all of the numerous books can not be read by the members, and the instructor will have to pick out certain books or chapters which seem most important or interesting, and to give short reviews of the others himself.

There are a great many important books and pamphlets about which a student of zoology ought to know something and which he can not possibly read all by himself, especially if they be written in a foreign language. More than one book in German or French can not be expected from a student per semester or per year, but when each member of the seminar reads one book, something can be accomplished for the mutual benefit. The instructor gives the necessary explanations,

shows specimens, or at least pictures, charts and diagrams, performs experiments, if necessary, and directs the discussion.

III. The instructor prepares a list of books or papers which all relate to the same subject, and which he wishes to discuss with his students. He announces, say, a seminar on Darwinism, and either asks the members to report on some books of Darwin's, Wallace's, Häckel's, Romanes's, Weismann's, etc., or gives them some of the modern pamphlets dealing with evolution, heredity, variation, etc., for instance, Weismann's 'Germinal Selection,' Götte's 'Heredity and Adaptation,' Pfeffer's 'Transformation of Species,' some of Karl Pearson's papers, Cunningham-Weldon's controversy, some of Davenport's papers, etc.

IV. The instructor announces a seminar, say, on evolution. He makes out a list of topics relating to this special subject in such a way that they all together will more or less exhaust it. Such a list would be, for instance: Classification of organisms before and after Darwin. Geological and geographical distribution of plants and animals. Australia. Lamarck, Darwin, Wallace. Fertilization. Heredity. Variation. Species. Anthropoid apes. Pithecanthropus and the Engis, Spy and Neanderthal, Mentone and Cro-magnon skeletons. La Madelaine, Hallstadt, La Tène. Lake-dwellings, ancient and modern. Human races. Each member chooses one topic and makes himself acquainted with the main literature, prepares demonstrations and experiments, procures pictures and diagrams and works out a little lecture to be given before the seminar.

It is also a good idea to have these lectures written in the form of little essays which circulate among the members of the seminar after the lectures have been delivered and are, with their remarks on the margin, finally handed in to the instructor. In a later session the latter returns them and gives his criticisms both of the paper and the annotations.

V. In the same way, of course, a number of unconnected topics may be chosen. The instructor may want to have certain subjects brought up upon which the general interest happens to be focused, or he may have discovered certain deficiencies in the studies of his students which they would be thus obliged to make up. The same method will enable him also to complement, as it were, his lectures and laboratory courses by treating certain topics a little more fully than he can afford in his regular course.

VI. So far the teaching or imparting of knowledge has been in the foreground; but still another idea can be accepted as the leading principle: thinking, which leads to research. In other words, all the steps may be gone through which have led to some important discovery, or the history of a problem may be followed up to its latest aspects. Here, of course, the original papers will have to be used to a much larger extent, and especially all the pros and cons will have to be brought out. We may take, for instance, all the different steps which finally have led to the discovery of the cycles of the parasites of malaria. (Laveran, Golgi, Labbé, MacCallum, Ross, Grassi, Ziemann, Koch, Grassi and others.) Or, taking fertilization, we might have: The old spermatists and ovulists, Schwann's work on the cells, Leuckart's article on reproduction; Darwin, Weismann; Flemming, Van Beneden, Fol, Carnoy; Bütschli, O. Hertwig, Conklin, Mark, Wilson; Rückert, Häcker; Meves; Boveri; Loeb, Morgan, Wilson; Maupas and R. Hertwig; Calkins.

VII. The method can also be used in laboratory studies, each member making a certain preparation, constructing a certain apparatus, making a diagram or chart, etc. In this way two birds, or three, might be killed with one stone; the member in charge is obliged to study and acquire a certain skill and certain methods to do his part as well as possible; the other members get the benefit of the demonstration, and the laboratory finally acquires for its collection some dissection, microscopic preparation, some piece of apparatus, a chart, some lantern-slides, etc.

VIII. A plan may be adopted which amounts to cooperation. In this way a résumé of a certain question may be given, for instance, a paper on the present aspect of

the problem of gastrulation may be prepared and published. Each member takes one group, such as the different types of fishes, amphibia, reptiles and so on, goes over the literature and works out his account. The whole thing is then put together, added to and got ready for publication by the instructor.

IX. For the sake of completeness I wish to mention here the so-called zoological clubs or research clubs, where each member gives a piece of his own research, and the journal clubs. In the latter, each member takes one or a number of journals and gives a report of all the papers which have been published therein, which seem of a more general interest, or the papers are assigned to the members, or each member selects a specialty and reports in his turn on all the new papers in this line.

The advantages of the seminar method, it seems to me, are the following : (1) we are more able to give our students an idea of the many-sidedness of a modern science. A young student, after having heard the usual lectures and done his laboratory work, may be ready to believe that there are some more animals which he did not study and that some things and courses may be given which could not be offered, or he could not take; but on the whole he is apt to believe that, having done what was required of him, he knows now about what can be known on the subject in question. A seminar may have the not very pleasant but useful task of showing him how little he knows; that is to say, it can give the students an idea of the different points of view from which we may look at the very things which they have studied, the different ways in which we may combine them in order to find our way to a deeper knowledge, to gain a new truth. There is not always time and opportunity to discuss a question or attack a problem from several sides in a lecture; we can at best allude to that; and in the laboratory the main object ought always to be the most careful and exact observation of a few forms. In fact, perhaps, nothing but established facts or accepted theories and hypotheses ought to be brought up in the lectures, in the laboratory nothing but points which can be demonstrated or actually studied; the seminar is the place to give new ideas, to open new ways of looking at things, new connections and associations, to discuss uncertain points with their pros and cons, and to oblige the students to form an opinion of their own. In a seminar on Darwinism, for instance, we must offer and discuss, not only the points brought up by Nägeli, Eimer, Wolff, Dreyer, Götte, Cunningham, etc., but we must also see what Fleischmann has to say, and must let our students find his weak points.

(2) It seems to me that we often give, and have to give, certain things in our lectures which ought not to be given there. While I strongly believe that a careful study of anatomy or morphology is still and, after all, the only basis of all our further studies, be they physiological, psychological, bionomical and ecological or what else, it might, perhaps, be better to give in our lectures, aided by demonstrations, charts, models, lantern slides, etc., only the general outlines, the fundamental laws, certain views, certain points of the life history, habits, etc., and to leave details for a seminar. It is wonderful to develop before an audience the primitive forms of the embryo with the aid of models, clay and cloths of different colors, but when it comes to the details of the development of the vessels, muscles and the skeleton, the interest decreases equally with the student and with the teacher. In osteology the general features and arrangements of the bones in one animal, in a group or in the entire series of vertebrates, may profitably be explained in lectures; but the processes and their muscular attachments, the foramina and their passing nerves and vessels, and the details of the bones themselves, the peculiar twist, for instance, of femur and humerus, or of the ribs, are a rather dry subject for the hearer and unsatisfactory to lecture on for the instructor. What can not be covered by regular laboratory work could be treated in a seminar.

Especially helpful does the seminar appear in systematic zoology. Lectures on systematic zoology must always seem more or less unsatisfactory, even when supported by much demonstration material, because there are neces-

sarily too many names and too many, and often too fine, distinctive characters. In a seminar one group after another can be taken up. Each member studies one group, familiarizes himself with the characteristics, data, life histories, etc., and gives his demonstration. In a beginners' seminar the main groups may thus be treated; in an advanced seminar a small group may be studied more completely, and the members will have an opportunity to familiarize themselves with the main literature on the group, etc.

(3) A seminar can give the student an opportunity to see and compare more material than is possible in the laboratory course, and to see it better than is possible in a lecture or in the few minutes just before and after the lecture. The knowledge and faculty of observation gained by previous laboratory work enables the student to get a great deal out of the demonstration of comparatively much material which passes through his hands in a seminar. A student may have had, say a course in the dissection of an animal, the frog or the cat, for instance, and he may also have taken a course in comparative anatomy, and dissected a number of types such as *Amphioxus, Petromyzon,* a teleost, an amphibian, a reptile, a bird and a mammal. Then in a seminar it may seem desirable to study the different groups of fishes or amphibia more carefully. Each member makes a preparation of one system, or of all the systems of one animal, and gives his talk and demonstration on it. (Some of the better dissections may then be added to the museum.) Some skillful member may even be trusted with a dissection of a cœcilian, or the instructor may do that himself. Or the sexual organs, the nervous system, may be taken and studied in the seminar by means of demonstrations, microscopic slides and talks prepared by the individual members. Such a series for the sexual organs would be: *Petromyzon, Myxine* and *Bdellostoma; Amia, Lepidosteus* and *Acipenser;* Teleosts: *Perca, Salmo* or *Esox* for the male, *Perca, Esox* and *Salmo* for the female, *Serranus, Embiotocus; Protopterus* and *Ceratodus; Scyllium, Mustela lævis, Raja, Chimæra; Necturus, Cryptobranchus, Diemyctilis* and *Triton, Amblystoma, Plethodon, Rana, Bufo;* cœcilian; snake, turtle, lizard, crocodile; bird; *Echidna* and *Ornithorhynchus,* marsupial, rabbit, cat, bat, monkey, man.

(4) Each member may work his studies into a little written composition which afterwards circulates among all the other members, who may add remarks and ask questions, and is finally handed in to the instructor. This work, it seems to me, is much more valuable to the students than keeping note-books. As we all know, note-books are a very doubtful means of education. They do not prove that the student has mastered the subject, for we have often seen students coming together and one of them dictating what the others put down with little individual changes. In other cases, the temptation of copying from books is too great. Under these circumstances, it seems an enormous waste of time for the student to say in his imperfect way what others have said ten times better, more clearly and correctly, and what he ought to read, or to have read, along with his studies, just as well as for the instructor to spend his time in correcting them, which he ought to spend in doing original work. The seminar obliges the student to work a subject up, making himself thoroughly familiar with it, and then present it in a way which, while it is not original research, certainly means an individual representation, and, as such, is an important step towards independent work.

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BOTANICAL NOTES.

STUDIES OF WATER MOLDS.

DR. BRADLEY M. DAVIS, of the University of Chicago, has just issued a quarto pamphlet of thirty-two pages, accompanied by two large plates devoted to the oogenesis of certain species of water molds (*Saprolegnia*). The paper appears as one of the Decennial Publications of the University of Chicago, and is well worthy of appearing in this notable series. The treatment is modern, and Dr. Davis is quite inclined to cut across some of the views which have fastened themselves

upon the morphology of the water molds and their relatives. While it is impossible to summarize this paper here, the present reviewer wishes to express his hearty agreement with the conclusions reached by the author.

PROTOPLASMIC STREAMING IN PLANTS.

Dr. Alfred J. Ewart, of the Birmingham Technical Institute, England, has recently published an interesting book on the physics and physiology of protoplasmic streaming in plants which will attract the attention of cytologists and no doubt help to give a better idea of the mechanism of the streaming cell. The work is the outcome of a series of observations begun nearly ten years ago by the author and continued until quite recently. It takes up first the physics and chemistry of the subject, and this is followed by the physiology, and then by a theoretical and general discussion. A few results may be summarily indicated as follows:

The movement is generated in the protoplasm itself.

The velocity of streaming is largely dependent upon the viscosity of the protoplasm, and hence upon the percentage of water, being more rapid as the water is increased.

Gravity exercises little or no influence upon streaming in small cells, and only a very slight one in large cells.

High temperature affects streaming by decreasing the viscosity, and for each species of plant or cell there are minimal, optimal and maximal temperatures.

No special chemical changes are connected with the streaming of protoplasm.

In the strongest magnetic field little or no effect on the streaming is noticed, but electrical currents may accelerate or, when strong, stop the movement.

Strong light retards streaming, while weak light may accelerate it under certain circumstances.

The book is one which must commend itself to plant physiologists.

FORESTRY IN NEBRASKA.

Several years ago the Nebraska Park and Forestry Association was organized for the purpose of encouraging tree planting for economic as well as ornamental purposes. This organization has just issued a 'Park and Forestry Manual' which calls attention to the kind of work which such an organization may do for a community. This little manual of nearly one hundred pages contains many suggestive articles. There is first a short article giving the origin of arbor day, followed by one on the 'Forests and Forest Trees of Nebraska.' Following this is another on 'Tree Planting on Nebraska Prairies,' and then in succession 'Propagation of Forest Trees,' 'Raising Evergreens from Seed,' 'The Nebraska Forest Reserves,' 'Tree Planting in School Yards,' 'Trees and Orchards,' 'Success or Failure in Timber Claim Planting and Causes for It,' 'Home Adornment and Public Parks,' 'The Red Cedar for a Screen or Shelter' and 'Annotated List of Nebraska Trees.' This manual might well be imitated by similar organizations in other states.

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*MODERN VIEWS ON MATTER.**

The Romanes lecture was delivered in the Sheldonian Theater, Oxford, on June 12, by Sir Oliver Lodge, F.R.S., principal of the University of Birmingham, the subject being 'Modern Views on Matter.'

The lecturer began by saying that he would discriminate between theses which were generally accepted by physicists and speculative opinions or hypotheses which were now being thrown out on the strength of experimental evidence of an at present incompletely conclusive, but very suggestive, character. The first thesis was that an electric charge possessed the fundamental property of matter, called mass or inertia, and that if a charge were sufficiently concentrated it might represent any amount of matter desired. There were reasons for supposing that electricity

* From the London *Times*.

existed in such concentrated small portions, which were called 'electrons,' and could either be associated with atoms of matter, to form the well-known chemical ions, or could fly separate, as was observed in the cathode rays of vacuum tubes, and in the loss of negative electricity when ultra-violet light fell upon a clean negatively charged surface. The lecturer went on to say: The hypothesis suggested on the strength of these facts is that the atoms of matter are actually composed of these unit electric charges or electrons, an equal number of positive and negative charges going to form a neutral atom, a charged atom having one electron in excess or defect. On this view a stable aggregate of about 700 electrons in violent orbital motion among themselves would constitute a hydrogen atom, 16 times that number would constitute an oxygen atom, and about 150,000 would constitute an atom of radium. The attractiveness of this hypothesis is that it represents a unification of matter and a reduction of all material substance to a purely electric phenomenon. The strongest argument in its favor is that mass or inertia can certainly be accounted for electrically, and that there is no other known way of accounting for it. If matter is not electrical, then there are two distinct kinds of inertia which exactly simulate each other's properties. Assuming this electrical theory of matter, that the atoms are aggregates of electric charges in a state of violent motion, two consequences follow. One of these consequences depends on the known fact that radiation or light, or an ether wave of some kind, is emitted from any electron subject to acceleration; consequently the revolving constituents of an atom must be slowly radiating their energy away, must thus encounter a virtual resistance, and must in that way have their velocity increased. The second consequence is that when the speed of an electrified body reaches that of light its mass becomes suddenly infinite; and in that case it appears not improbable that a critical condition would have been reached at which the atom would no longer be stable, but would break up into other substances. And recently during the present year a break-up of the most massive atoms has been observed by Rutherford, and has been shown to account for the phenomenon of radio-activity, some few of the atoms of a radio-active substance appearing to reach a critical stage, at which they fling away a small portion of themselves with great violence, the residue having the same property of instability for some time, until ultimately it settles down into presumably a different substance from that at which it started. The matter flung away appears to be a light substance not very different in atomic weight from hydrogen or helium, and it is surmised that possibly certain chemical inert elements may be the by-products of radio-activity; and that this process of dissociation of the atom may constitute the evolution of the chemical elements, such as has, on theoretical grounds, already been speculatively surmised. An analogy, the lecturer said, may be drawn between this supposed gradual collapse of an atom and the contraction of a nebula, which at certain stages becomes unstable and shrinks off a planet, the residue constituting an extremely radio-active mass or sun. But, whereas the astronomical changes observed in cosmic configurations of matter occur in a time reckoned in millions of years, the changes to be expected in the more stable atoms would seem likely to require a time reckoned in millions of millions of centuries; but, nevertheless, according to known laws, and on the hypothesis of electric constitution, the change seems bound ultimately to occur; and so a state of flux and decay is hypothetically recognized, not only in the stars and planets, but in the foundation-stones of the universe, the elemental atoms themselves. A process of regeneration, however, is also thinkable, and would occur if the separate electrons were ever to aggregate themselves together by their mutual attractions into fresh material. And, inasmuch as the life of a highly radio-active substance must be very limited, being, perhaps, not more than a few thousands of years in some extreme cases, it appears necessary to assume that some such regenerative process is constantly at work, and that, just as we have

suns of various ages and exhibiting the process of evolution in different stages, so it may be that the progress of research will lead us to recognize the existence of atoms of matter in like case, some recently formed, and some very ancient; and the whole argument seems to lead to an atomic astronomy of surpassing interest.

SCIENTIFIC NOTES AND NEWS.

M. Amagat, of the Paris Polytechnic School, has been elected a member of the Paris Academy of Sciences in the section of physics, and Dr. H. A. Lorentz, professor of physics at Leiden, has been elected a correspondent in the same section.

Lord Kelvin and Lord Lister have been elected honorary members of the Royal Society of New South Wales.

Lord Lister, in recognition of his 'long and valuable services to the country and particularly to surgery by the discovery and application of the antiseptic treatment,' has been admitted to the honorary freedom of the Merchant Taylors' Company, London.

Dr. W J McGee has been appointed chief of the Department of Anthropology and Ethnology at the Louisiana Purchase Exposition.

Dr. Philip Henry Pye-Smith, F.R.S., has been reelected chancellor of the University of London.

Dr. G. von Escherich, professor of mathematics, has been made rector of the University of Vienna.

The University of Groningen has conferred an honorary doctorate of mathematics and astronomy on Dr. C. Easton, director of the Observatory at Rotterdam.

Dr. F. Hofmann, professor of experimental hygiene at Leipzig, has celebrated the twenty-fifth anniversary of his professorship.

Dr. B. E. Livingston, instructor in plant physiology in the University of Chicago, has been granted a research scholarship in the New York Botanical Garden, beginning September 1, 1903.

For the Michigan State Geological Survey Dr. A. W. Grabau will continue his studies of the Dundee and Traverse Limestones of the state, which are proving of great economic value. The survey has just issued a report on Portland cement, clay and coal, and soon expects to issue one on gypsum by Professor G. P. Grimsley. Dr. F. E. Wright, of the Michigan College of Mines and Geological Survey, is conducting some investigations of the copper-bearing rocks of the Porcupine Mountains. Mr. Leon J. Cole has prepared a study of the growth of the St. Clair Delta. Mr. Robert Muldrow is mapping the quadrangle around Detroit for the U. S. Geological Survey in conjunction with the State Survey. Mr. Lane's papers on the water supply of Michigan being entirely exhausted, the State and U. S. Geological Surveys are actively engaged in preparing for revised and extended editions. Messrs. R. E. Horton, W. M. Gregory and W. F. Cooper are engaged in this work.

The present board of visitors of the Royal Observatory, Greenwich, is composed as follows: Sir W. Huggins, Professor H. H. Turner, Professor W. G. Adams, Professor J. Larmor, Sir J. N. Lockyer, Lord Rayleigh, Lord Rosse, Sir A. Rücker, Sir W. Abney, Sir R. Ball, Professor R. B. Clifton, Dr. J. W. L. Glaisher, Professor G. H. Darwin, Rear-Admiral Sir W. J. L. Wharton, Mr. W. D. Barber.

Dr. J. E. Dutton and Dr. J. L. Todd, principals of the Trypanosoma Expedition of the Liverpool School of Tropical Medicine, have returned to England from Senegal, where they have been investigating trypanosomiasis, a human disease similar to the tsetse fly disease which is the chief cause of mortality among the horses.

The following British civil list pensions have geen granted: £100 to Mrs. Adelaide Fanny Eyre in consideration of the services of her late husband, Mr. Edward John Eyre, the Australian explorer and Governor of Jamaica; £120 to Mrs. Zare Elizabeth Blacker in recognition of the services of her late husband, Dr. A. Barry Blacker, who lost his life

through his devotion to medical research; and £105 to Mr. James Sully in recognition of his services to psychology.

MR. WILLIAM E. DODGE, chairman of the committee appointed by Mayor Low to raise an endowment fund for Cooper Union as a memorial to Abram S. Hewitt, sent to the mayor a check for $211,310, which has been transferred to the treasurer of Cooper Union. Twenty-one persons contributed to the fund, including Andrew Carnegie, $55,000; John D. Rockefeller, $50,000; J. Pierpont Morgan and William E. Dodge, $25,000 each; George F. Baker, Jacob H. Schiff and Henry Phipps, $10,000 each.

THE Lord Mayor of Belfast is chairman of a committee that will present to Queen's College, Belfast, a portrait of Dr. J. W. Byers, professor of the diseases of women and children.

THE Misses Gladstone have presented to the Royal Institution the portrait of the late John Hall Gladstone, formerly professor of chemistry in the Institution.

DR. F. BAUER, docent in the Munich Institute of Technology, has been killed by an Alpine accident at the age of thirty-three years.

DR. P. H. KELLER, honorary professor of physics at the University of Rome, has died at the age of seventy-seven years.

SIR GEORGE STOKES bequeathed his scientific apparatus to the University of Cambridge. It has been distributed among the Chemical, Physical and Mineralogical Departments.

THE library of the late Professor Schade, formerly director of the surgical clinic of the University of Bonn, has been presented to the clinic by his widow.

MRS. MARY E. RYLE has given $130,000 toward the construction of a new library building at Paterson, N. J.

THE Royal Academy of Belgium offers next year its Charles Lagrange prize of the value of 1,200 francs for a paper adding to our mathematical knowledge of the earth. It also offers the Theophile Gluge prize of the value of 1,000 francs for the best work on physiology. The following year it offers its De Selys Longchamps prize of the value of 2,500 francs for the best original work on the fauna of Belgium. These prizes are open to foreigners.

THE bill which passed the Michigan legislature, and was supported by the Michigan Academy of Science, providing for a biological survey of the state under the supervision of the state geologist, unfortunately failed to receive the approval of the governor. The state geologist was called east just at the close of the legislature by the death of his brother, Mr. L. P. Lane, of the Statistical Department of the Boston Public Library.

THE Sanitary Institute of Great Britain held its twenty-first congress at Bradford during the second week of July under the presidency of Lord Stamford.

THE Association of German Engineers met at Munich at the end of June.

THE sixth International Congress of Psychology, which was to have met in Rome in the autumn of 1904, will be postponed to the spring of 1905 to avoid conflict with the sixth International Congress of Physiology which meets at Brussels in the autumn of 1904.

AT a meeting held recently in Manchester it was unanimously resolved that it is desirable to hold an international exhibition in that city in 1905.

A STOCKHOLM correspondent writes, on July 5, to the London *Times*, that the Norwegian steamer *Frithiof*, chartered by this expedition, will arrive from Tromsö in a few days for outfitting. It is expected that the ship will be ready to start about the middle of August. Lieutenant Blom, of the Swedish navy, who two years ago accompanied the trigonometrical survey expedition to Greenland, has been appointed second in command. The young Swedish zoologist, Baron Klinckowström, will also accompany the *Frithiof*. Three expeditions are thus now hurrying to the rescue of de Nordenskiold and his companions. The Swedish, on board the *Frithiof;* the Argentine, in the *Uruguay;* and the French, in the *Français*.

THE official report of Professor Drygalski on the German Antarctic expedition was

published on July 10, in a special supplement of the *Imperial Gazette*. According to Reuter's Agency the report begins with the start from Kerguelen on January 31, 1902. The ship reached the Heard Islands on February 3, from which point the regular South Polar voyage began. The *Gauss* proceeded in a southeasterly direction towards a land the existence of which was reported by the Wilkes expedition, but placed in doubt by the Challenger expedition. After a rough voyage the first drift ice was reached in February 13 at 61° 58′ south latitude, 95° 8′ west longitude. From the 18th to the 22d of February, 1902, an effort was made to make a good push southward, but this was stopped, the *Gauss* being fast caught in the ice and thus compelled to lie up for the winter. Professor Drygalski christened the bay in which the *Gauss* lay Posadowski Bay, and the ice-free volcanic peak, 1,200 feet high, on the south side of the *Gauss* was named the Gaussberg. On February 8, 1903, the *Gauss* was set free by a strong easterly wind, and went along the northern edge of the western ice, which she finally lost sight of on February 19, 1903, in 65° 32′ south latitude and 87° 40′ east longitude. She then drew near to the ice again, and was held fast from March 6 to March 14 for a second time. She again managed to reach the open sea, in which she advanced as far as 64° 51′ south latitude and 8° 14′ east longitude. Traveling became difficult owing to the ever-growing length of the nights. On April 8, 1903, it was determined to turn back northward at 64° 58′ south latitude and 79° 33′ east longitude. On April 8 Kerguelen was passed, and on June 9 Simons Town was reached, all well.

'Furthest South with the Discovery,' Lieutenant Shackleton's narrative, with illustrations of the first eighteen months' work of the National Antarctic Expedition under Captain Scott, has been acquired for publication by the *Illustrated London News*. The first part of the narrative was promised for June 27, as a supplement to the ordinary number of the *Illustrated London News*.

The London *Times* states that at the invitation of Lord Lister and the governing body of the Jenner Institute about 100 gentlemen traveled down to Elstree on July 3 to inspect the new antitoxin department of the Jenner Institute of Preventive Medicine. With Lord Lister were Lord Iveagh, Sir Michael Foster, Sir Henry Roscoe and Mr. J. Luard Pattisson, members of the governing body, and Dr. Macfadyen, chief bacteriologist. The resident staff, consisting of Dr. George Dean, Dr. Todd and Dr. Petrie, received the party at Elstree and conducted them over the establishment, which is devoted to the preparation of antitoxins on a commercial scale, and to the experimental investigation of questions connected with immunity. This department of the institute's work used to be carried on at Sudbury, but, in consequence of compulsory disturbance to make room for the Great Central Railway, it has been transferred to Queensberry-lodge, near Elstree. The institute is fortunate in having secured so good a site. The place was formerly a breeding stable, and it contains first-rate accommodation for 36 horses. Each animal has a loose-box of the most modern and sanitary type. There was, in addition, a small house, which affords room for two members of the staff and is surrounded by a large garden and some 23 acres of meadowland. The whole stands high in a healthy, isolated and wholly rural situation. A suite of laboratories has now been added. They are most conveniently arranged and constructed according to the latest requirements, with papyrolith floors having rounded corners, glazed adamant walls, white tiles and large windows. In the garden are isolated houses for the smaller animals. The visitors, who inspected the whole establishment with the interest of experts, were greatly pleased with the construction and arrangement of the premises. They were particularly struck with the healthy and well-kept-up appearance of the horses, and with the cleanliness and order maintained in every part of the establishment.

Reuter's Agency reports that the Liverpool School of Tropical Medicine has received a report from the Suez Canal Company on the

subject of the result of Major Ross's recommendations for the improvement of the sanitary conditions at Ismailia, with special reference to the campaign against mosquitoes. Major Ross, accompanied by Sir William MacGregor, went out to Ismailia in the autumn of last year to study the question of the prevalence there of malaria. Major Ross was sent out by the Liverpool School of Tropical Medicine, at the special request of Prince d'Arenberg. The report begins by referring to a statement made quite recently by the principal medical officer of the Sudan to Major Ross that the sanitary state of Ismailia is now much improved. The secretary-general proceeds to say that since the visit of the expedition of the school to Ismailia in September last several important drainage works have been undertaken, including the filling up of water puddles, and that a special service had been created for the purpose of supervising this work, specially charged with the duty of pouring oil on the pools and disused wells, doing away with marshes, puddles, etc., existing in and near the residential quarters of Ismailia. On the other hand prophylactic measures, such as gratuitous distribution of quinine, 'liqueur de Fowler,' have been continued without interruption since April, 1902. In December the number of cases of fever had decreased in a most marked manner compared with preceding months and the corresponding month in the previous year. The secretary-general states that this diminution in fever has been maintained up to the date of writing—namely, July 2 in the present year. Thanks to systematic oiling of pools and to the unceasing watch kept over all likely places where larvæ can be hatched, the ordinary mosquitoes of the genus culex and stegomyia have been annihilated almost absolutely, and even in the worst period of the hot season it has been found possible to dispense with the use of mosquito nets. The secretary-general ends with a testimony to the value of the work of the expedition, and says they have every hope that the assistance rendered by Major Ross will result in the complete abolition of malaria from the town of Ismailia.

THE U. S. Geological Survey has just issued a list, complete up to June, 1903, of its serial publications, consisting of Annual Reports, Monographs, Professional Papers, Bulletins, Mineral Resources, Water-Supply and Irrigation Papers, Topographic Atlas of the United States, and Geologic Atlas of the United States. Monographs, topographic sheets and geologic folios are sold at cost of publication —topographic sheets (of which indexes, free on application, are published from time to time) are sold at 5 cents each, or $2 per 100 in one order; geologic folios usually at 25 cents each; the other publications are distributed free. The latest professional papers are: No. 15, 'Mineral Resources of the Mount Wrangell District, Alaska,' by W. C. Mendenhall and F. C. Schrader; No. 16, 'Carboniferous Formations and Faunas of Colorado,' by G. H. Girty; No. 17, 'Preliminary Report on the Geology and Water Resources of Nebraska West of the One Hundred and Third Meridian,' by N. H. Darton; No. 18, 'Chemical Composition of Igneous Rocks expressed by means of Diagrams, with reference to rock classification on a quantitative chemico-mineralogical basis,' by J. P. Iddings. The latest bulletins are: No. 213, 'Contributions to Economic Geology, 1902,' S. F. Emmons and C. W. Hayes, geologists in charge; No. 214, 'Geographic Tables and Formulas,' compiled by S. S. Gannett; No. 215, 'Catalogue and Index of the Publications of the United States Geological Survey, 1901 to 1903,' by P. C. Warman; No. 216, 'Results of Primary Triangulation and Primary Traverse, Fiscal Year 1902–3,' by S. S. Gannett. The latest water-supply papers are : No. 80, 'Relation of Rainfall to Run-off,' by G. W. Rafter; No. 81, 'California Hydrography,' by J. B. Lippincott; Nos. 82, 83, 84, 85, 'Report of Progress of Stream Measurements for the Calendar Year 1902,' by F. H. Newell; No. 86, 'Storage Reservoirs of Stony Creek, California,' by Burt Cole. The latest geologic folios ready for distribution are: No. 90, 'Cranberry, Tennessee'; No. 91, 'Hartville, Wyoming'; No. 92, 'Gaines, Pennsylvania, New York'; No. 93, 'Elkland-Tioga, Pennsylvania.' All the

above mentioned geologic folios are sold for 25 cents each. Application for any and all publications should be made to the Director, U. S. Geological Survey, Washington, D. C.

A NOTE in the *British Medical Journal* states that the opening up of Central and Eastern Africa has revealed the fact that instead of zebras being nearly extinct, these animals exist in large numbers on the banks of the Tama River and in the province of Ukamba. Unlike horses and cattle, they are proof against horse sickness and the fatal tsetse fly. At the present time, for land transport in war, mules are almost universally employed, and they are used for the carriage of mountain batteries. Professor Cossar Ewart has at Penycuik since 1895 been endeavoring by zebra-horse hybrids to 'evolve' an animal that shall be superior to the mule for the purposes for which that animal is usually employed. There are three kinds or types of zebras—namely, Grevy's zebra of Shoa and Somaliland, the mountain zebra (equus zebra), once common in South Africa, and known as the common zebra, and the widely-distributed Burchell group of zebras. The zebra-horse hybrids were obtained by crossing mares of various sizes with a zebra stallion, a Burchell's zebra; and the new animals get the name of 'zebrules.' They seem excellently adapted by their build and general make, as well as by the hardness of hoof, for transport purposes and artillery batteries. The zebra striping is often distinct, though in color they more generally resemble their dam. They stand fourteen hands high, with a girth measurement of sixty-three inches. Their temper seems to be better than that of the ordinary mule, and they are exceedingly active, alert and intelligent. The Indian government is giving them a trial in Quetta for mountain battery work, and they are being put, also, to a practical test in Germany.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Royal Geographical Society has appropriated £200 a year for five years, and the general board of studies of Cambridge University the same sum for a School of Geography at the university.

PROFESSOR W. N. FERRIN has been elected president of the Pacific University at Forest Grove, Oregon.

DR. ALLEN J. SMITH, present professor of pathology in the University of Texas, has been elected professor of pathology at the University of Pennsylvania, in succession to Dr. Simon Flexner, director of the Rockefeller Institute, New York.

MR. EDGAR JAMES SWIFT, A.B. (Amherst, 1886), who has held a fellowship at Clark University for the past two years and has just taken an examination for the doctor's degree there, has been appointed professor of psychology and pedagogy in the Washington University at St. Louis.

MR. M. E. STICKNEY, of Harvard University, has been appointed instructor in botany in Denison University to succeed Mr. W. W. Stockberger, resigned.

THE following appointments have been made at McGill University: Dr. J. G. McCarthy, to be assistant professor of anatomy; Dr. J. T. Halsey, to be assistant professor of pharmacology and therapeutics; Dr. R. A. Kerry, to be lecturer in pharmacology and therapeutics; Dr. S. Ridley Mackenzie, to be lecturer in clinical surgery; Dr. John McCrae, to be lecturer in pathology; Dr. D. A. Shirres, to be lecturer in neuro-pathology; Dr. D. D. McTaggart, to be lecturer in medico-legal pathology.

AT University College, London, Dr. Page May has been appointed lecturer on the physiology of the nervous system, and Mr. J. H. Parsons, lecturer on physiological optics.

A CHAIR of agricultural botany has been established at Rennes, with M. Danniel as professor.

DR. EMIL KRAEPELIN, professor of psychiatry at Heidelberg, has been called to Munich.

DR. W. LOSSEN, professor of chemistry at Königsberg, has retired.

DR. CARL HUGO HUPPERT, professor of medical chemistry at the German University of Prague, will retire at the end of the present semester.